

On the Genus *Chlorogomphus* (Anisoptera : Chlorogomphidae) of Indochina
with Descriptions of Six New Species and Little Known Species

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インドシナのミナミヤンマ属の覚え書き
— 6新種および希少種の記載 —

苅部治紀

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インドシナにおけるミナミヤンマ属は、これまでごくわずかな記録があるだけであったが、近年、筆者らの調査によって、各地からかなりの標本が収集されている。

今回は、この中から *Ch. yokoi* sp. nov. (タイ), *Ch. albomarginatus* sp. nov. (ベトナム), *Ch. nakamurai* sp. nov. (ベトナム), *Ch. sachiyoae* sp. nov. (ベトナム), *Ch. miyashitai* sp. nov. (ラオス), *Ch. takakuwai* sp. nov. (ベトナム) の6新種を記載し、さらに原記載以来80年ぶりの記録であり、初めてオスが知られる *Ch. auratus* Martin (ベトナム) を再記載した。また、*Ch. nasutus* Needham は、ベトナム国内から初めて記録されるものである。

Abstract. Six new species of the genus *Chlorogomphus* are described : *Ch. yokoi* sp. nov. from N. Thailand, allied to *Ch. arooni*, *Ch. albomarginatus* sp. nov. and *Ch. nakamurai* sp. nov. from N. Vietnam, all of which are similar to each other at first sight but consist an independent species group respectively ; *Ch. sachiyoae* sp. nov. from N. Vietnam, belonging to the same group of *Ch. kitawakii* from S. China, and *Ch. miyashitai* sp. nov. from NE Laos ; *Ch. takakuwai* sp. nov. from N. Vietnam, allied to *Ch. selysi* from India. In addition, *Ch. auratus* is redescribed after interval of about eighty years since the original description, and the male is first recorded.

Key Words : *Chlorogomphus*, Indochina, new species

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* All the holotypes designated in this paper are preserved in the Kanagawa Prefectural Museum of Natural History.

Key to the male of Indochina species of the genus *Chlorogomphus*

1. Triangles of hind wing rectangular ————— 2
- . Triangles of hindwing oblong ————— 5
2. Frons strongly protruded anteriad ————— 3
- . Frons almost flat or slightly protruded anteriad ————— 4
3. Superior appendage flat and slender, shaped as pincers.
- Inferior appendage shallowly excavated —————
- *sachiyoae* sp. nov.
- . Superior appendage robust with distinct lateral spines.

Inferior appendage deeply and triangularly excavated——
 —————*nasutus*

4. Superior appendage longer than the inferior, which is shallowly excavated———*takakuwai* sp. nov.

—, Superior appendage shorter than the inferior, which is deeply excavated———*miyashitai* sp. nov.

5. Abdominal segments 4-10th without any markings. Superior appendage short and robust. Inferior appendage short, with many spines at apex———

—————*nakamurai* sp. nov.

—, Abdominal segments 4-7th with yellow markings———
 —————6

6. 10th abdominal segment triangularly protruded———
 apicad———7

—, 10th abdominal segment moderate. Superior appendage shorter than inferior, with lateral spines.———

—————*albomarginatus* sp. nov.

7. Superior appendage very short. Inferior appendage stick-shaped, with many spines———

—————*yokoi* sp. nov.

—, Superior appendage longer than inferior appendage, which is expanded at middle and provided with two big spines at apex———

—————*auratus*

Key to the female of Indochina species of the genus *Chlorogomphus*

1. Triangles of hind wing rectangular or equilateral———2
 —, Triangles of hindwing oblong———5

2. Eyes widely separated. Abdominal 7th segment without any marking———3

—, Eyes moderately separated. Abdominal 7th segment with yellow marking———4

3. Body size middle. Wings slender. Tenth ventral lobe not exceeding paraproct———*sachiyoae* sp. nov.

—, Body size large. Wings broad. Tenth ventral lobe clearly exceeding paraproct———*nasutus*

4. Body size middle. Labrum with yellow markings. Seventh yellow marking spread along lateral side———

—————*takakuwai* sp. nov.

—, Body size large. Labrum without yellow markings. Seventh yellow marking like as ring———

—————*miyashitai* sp. nov.

5. Wings very broad, covered with black markings at about basal half———6

—, Wings broad, tinged with golden yellow———*auratus*

6. Eyes very widely separated. Vertex with a pair of protuberance———*nakamurai* sp. nov.

—, Eyes widely separated. Vertex without protuberances———*albomarginatus* sp. nov.

Chlorogomphus auratus Martin, 1910

(Figs. 1-11)

Chlorogomphus auratus Martin, 1910, Bull. Soc. ent. Fr., 66; Fraser, 1929, Mem. Indian Mus. 9 (3): 147-148.

Male. Abdomen (incl. appendage). 54.9-58.1mm in length. Hindwing 47.9-53.5mm in length, with maximum width 16.3-17.8mm.

Head largely black; labium whitish yellow; labrum black; anteclypeus black, with upper and lower edges brownish; postclypeus yellow except for black lower edge; ridge of antefrons broadly yellow; eyes almost adjacent, the distance 0.5mm; vertex eaves-shaped; occiput black, subconical.

Prothorax black, with anterior margin yellow. Pterothorax black with yellow markings; antehumeral stripe narrow, gently and gradually broadened dorsad; humeral stripe as wide as dorsal apex of the former; anterior 3/4 of metepisternum yellow; lower edge of metepimeron and metapoststernum yellow.

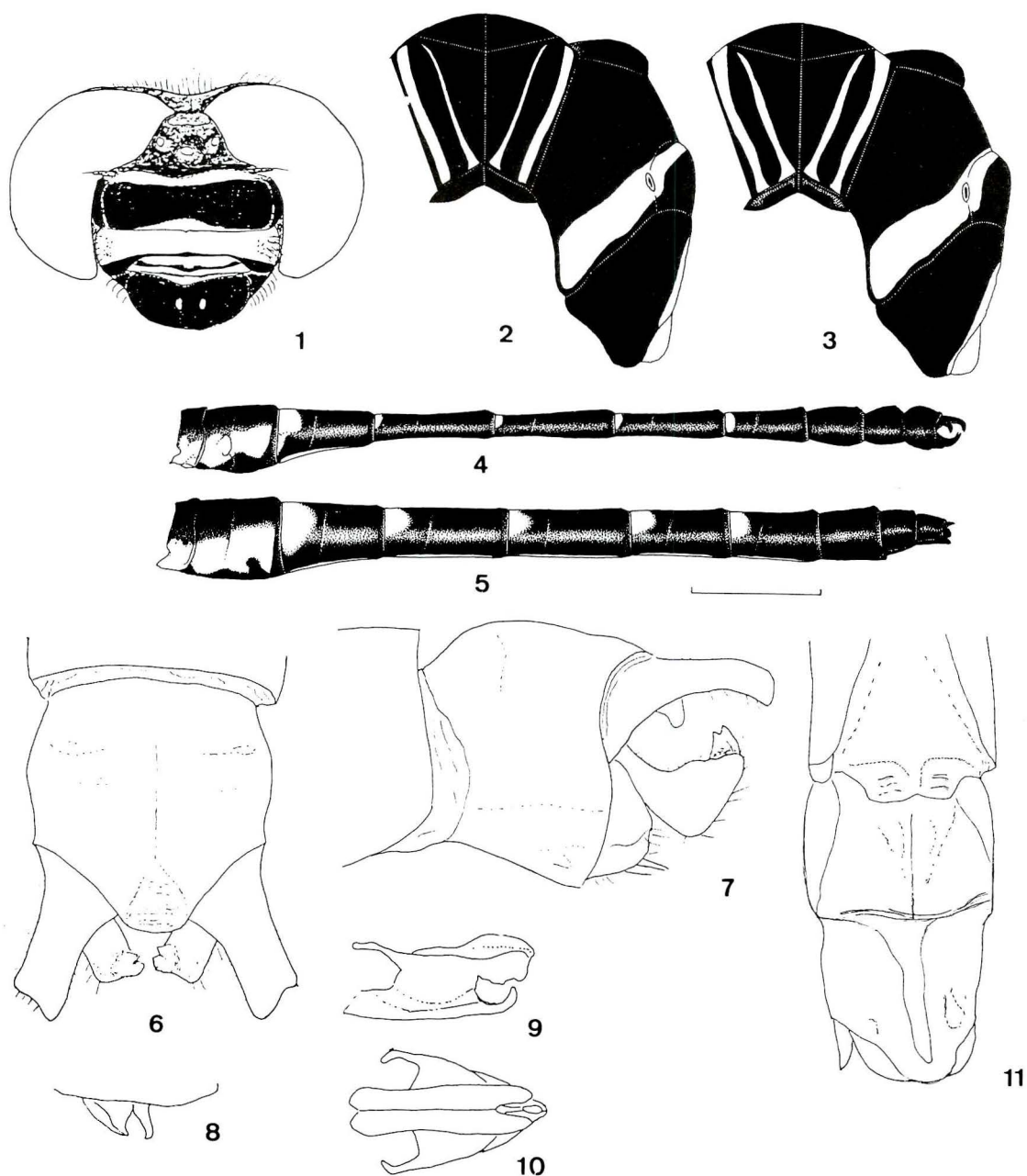
Wings nearly hyaline, with brownish marks at each apex; median space with 2 cross veins; triangles 3:3/3:3, 4:4/4:4, 4:3/3:3, 4:4/4:4, that of fore:basal:costal:distal=1:1.3:1.3, that of hind:basal:costal:distal=1:0.8:1.2; anal loop 18-21-celled; nodal index:15-28:29-16/18-23:23-18, 16-25:26-17/20-23:23-21, 17-28:29-17/20-21:23-22, 19-29:31-20/22-24:25-23; pterostigma black, 4mm in length and covered 4-celles in the fore, 4.2mm in length 3.5-cells in the hind.

Abdomen black, symmetrically with yellow markings as follows: spot at ventral half of 1st, broad, slightly oblique band running from antero-ventral part to middle part of posterior margin, which is connected with the former spot at anterior margin, stripe along ventral edge of 3rd, each antero-dorsal spot of 3rd to 7th, which is a little separated from one of the opposite site, the 3rd one being the largest and prolonged near ventral edge along anterior margin and 7th one being somewhat larger than the preceding 3; 8-10th entirely black; 10th broadly triangularly lobed at apex, the lobe being shallowly concave at median part and roundedly inclined downwards in apical part.

Caudal appendage black. Superior appendage widely and deeply furcate, the furcation becoming thinner from base to basal 1/3 and a little curved ventrad; lateral projection situated near apex. Inferior appendage robust, bilobed, rapidly thickened towards the middle in lateral view, the lobes strongly prolonged inwards and each with two spines at inner part of apex.

Accessory genitalia with anterior lamina rapidly becoming thinner towards apex; hamulus posterioris thick, with apex a little pointed anteriad.

Penis with vesicle shallowly, widely, longitudinally grooved at middle; 2nd strongly curved ventrad, with spine which is about 1/2 length of 3rd; 4th triangular, with a pair of



Figs. 1-11. *Chlorogomphus auratus* Martin.

2, 4, 6-10: male; 1, 3, 5, 11: female; 1: head in frontal view, 2, 3: thorax; 4, 5: abdomen; 6: caudal appendage in dorsal view; 7: same in lateral view; 8: accessory genitalia in lateral view; 9: last segment of penis in lateral view; 10: same in ventral view; 11: apical segments of abdomen in ventral view.

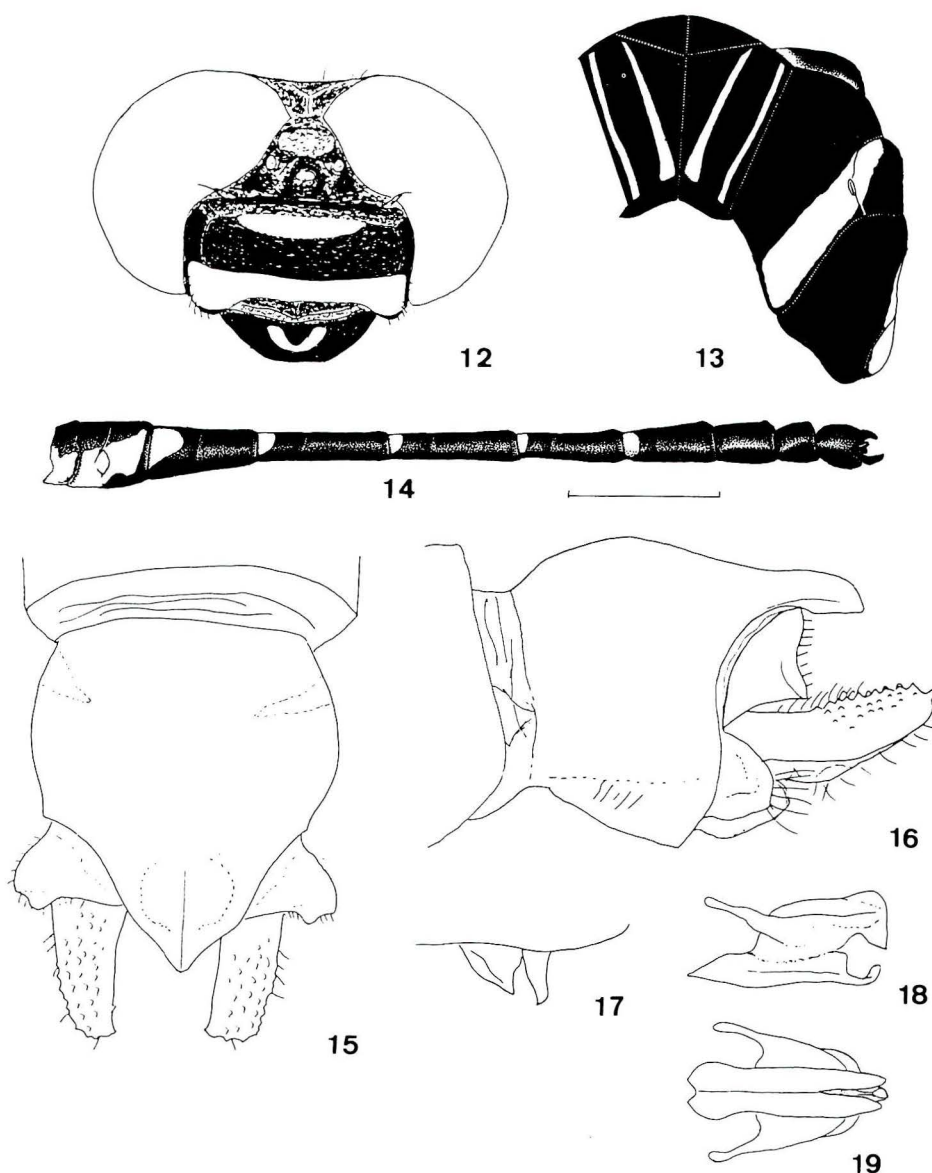
projections which are about $\frac{1}{3}$ length of 4th, with each apex of ventral plate robust which is strongly reflexed upwards, and with dorsal part apparently exceeding the apex of ventral plate, longitudinally grooved in anterior half, with a pair of distinct raisings along the groove, and somewhat obliquely truncate with slight excavity at apex in lateral view.

Female. Abdomen (incl. appendage) 59.5-65.2mm in length. Hindwing 54.7-60.3mm in length, with maximum width 19.7-22.5mm.

Maculate pattern similar to that of male, though more developed.

Head broader than in male; eyes more widely separated; vertex projected as eaves-shape, flat in dorsal part.

Wings golden yellow, often with brownish markings; each apex of wings with semicircular spot which almost covers distal area from pterostigma (some specimens without this marking or with broad transverse bands near node); median space with 2 cross veins; triangles 4:3/6:5, 4:4/5:5, 6:5/6:6, 4:4/4:



Figs. 12-19. *Chlorogomphus yokoi* sp. nov.

12: head; 13: thorax; 14: abdomen; 15: caudal appendage in dorsal view; 16: same in lateral view; 17: accessory genitalia in lateral view; 18: last segment of penis in lateral view; 19: same in ventral view.

5, 6 : 6/6 : 6, that of fore : basal : costal : distal = 1 : 1.3 : 1.4, that of hind : basal : costal : distal = 1 : 0.7 : 1.1; anal loop 20-27 cells (38 cells in one specimen); nodal index : 19-33 : 34-21/22-27 : 28-22, 18-31 : 31-17/19-24 : 25-19, 19-27 : 28-18/19-24 : 25-23, 18-30 : 29-19/21-23 : 23-22, 16-27 : 28-17/19-22 : 22-20; pterostigma black, 4.4mm in length and covering 4.5-cells in the fore, 4.6mm in length, and 4.5 cells in the hind.

Abdomen with marking pattern same in male; 2nd with broader oblique band and with a longitudinal median spot at apical 1/3 of dorsum; 3rd to 7th each with larger triangular spot at base and with stripe along ventral edge.

Cerci a little shorter than 10th. Valvula valvae broadly

trapezoidal, with apex slightly emarginate at middle. Ventral lobe of 10th faintly exceeding paraproct.

Distribution. N. Vietnam.

Materials examined. Mt. Tamdao, near Hanoi, N. Vietnam : 2 ♂♂ 2 ♀♀, 10. VII- VIII. 1990, Sinji Nagai leg; 1 ♀, 30. V. 1993, H. Karube leg; 1 ♂ 1 ♀, 31. V. 1993, H. Karube leg; 1 ♂ 1 ♀, 19. V- 2. VI. 1993, native leg; 3 ♂♂ 2 ♀♀, 3. V. 1994, H. Karube and S. Nirasawa leg.

Notes. Fraser, 1929 regarded this species as a member of group of *magnificus*, but Asahina, 1981 treated as a species allied to *arooni*. It became clear that this species surely belongs to the group of *arooni* by the present study including male

specimens, the characters of which are first described in this paper.

Chlorogomphus yokoi sp. nov.

(Figs. 12-19)

Male. Abdomen (incl. appendage) 55.8mm in length. Hindwing 47.1mm, with maximum width 15.5mm.

Head black with yellow markings; labium brownish yellow; labrum black with yellow V-shaped mark at the middle; anteclypeus black; postclypeus yellow, with lower edge black; antefrons black, with yellow band at upper edge; eyes almost meeting, the distance 0.8mm; vertex swollen as eaves-shape, with dorsal part almost flat; occiput black and pyramidal.

Prothorax black, with margins yellow. Pterothorax black with yellow marks; antehumeral stripe gradually becoming broader towards upper apex; humeral stripe thin, about half narrower than the upper apex of the former; mesinfraepisternum black; metepisternum largely yellow, anterior part of metinfraepisternum yellow, which is connected with the former; lower edge of metepimeron and metapoststernum yellow.

Wings hyaline, with brownish marks at each apex; median space with two cross veins; triangles 3 : 3/3 : 3, that of the fore : basal : costal : distal = 1 : 1.1 : 1.1, that of the hind : basal : costal : distal = 1 : 0.8 : 1.1; anal loop 13/13-celled; nodal index : 13 : 24-21 : 12/15 : 17-16 : 17; pterostigma of fore wings 3.8mm in length and covering 3.5 cells in the fore, 4.1mm in length and 3.5 cells in the hind.

Abdomen black with yellow markings; 1st segment with ventral 1/3 yellow; 2nd with broad oblique band running from antero-ventral area to postero-dorsal area and connected with the former yellow mark; 3rd to 7th each with a pair of yellow spots at antero-dorsal border, of which the 3rd ones are triangularly expanded and almost cover basal 1/3, and of which the 7th ones slightly larger than the preceding 2; 8-10th entirely black; 10th rounded at sides, broadly triangularly projected posteriad, the projection dully pointed at the tip in dorsal view and with a longitudinal cicatrix at apical 3/4.

Caudal appendage black. Superior appendage very short, triangularly protruded laterad, with two vague projections at apex. Inferior appendage slender, very faintly curved inwards in dorsal view, spindle-shaped in lateral view, slightly curled inwards, gradually curved upwards and thinned in apical half; surface densely granulate in more than apical half, the granules rather subconical.

Accessory genitalia with anterior lamina robust but rapidly tapered near apex; hamulus posterioris straight and thick, thinned in apical half, with a little pointed anteriad at apex.

Penis with vesicle solid, shallowly, widely, longitudinally grooved at middle; 2nd strongly curved ventrad, with spine which is about 1/3 times as long as 3rd; 4th triangular, with a

pair of projections which are about 1/2 length of 4th, with ventral plate deeply bilobed, each the lobe being somewhat robust and nearly vertically reflexed near apex, with dorsal part slightly exceeding the apex of ventral plate, longitudinally grooved in anterior 1/4, with a pair of distinct raisings along the groove, and vertically truncate and acutely angulately projected downwards at apex in lateral view.

Female. Unknown.

Distribution. N. Thailand.

Type materials. Holotype, ♂, Nan, N. Thailand, 24. IV. 1992, native leg.

Notes. This new species very closely related to *Chlorogomphus arooni* from Peninsula Thailand, but easily distinguished from that by the male anal appendage.

Chlorogomphus albomarginatus sp. nov.

(Figs. 20-30)

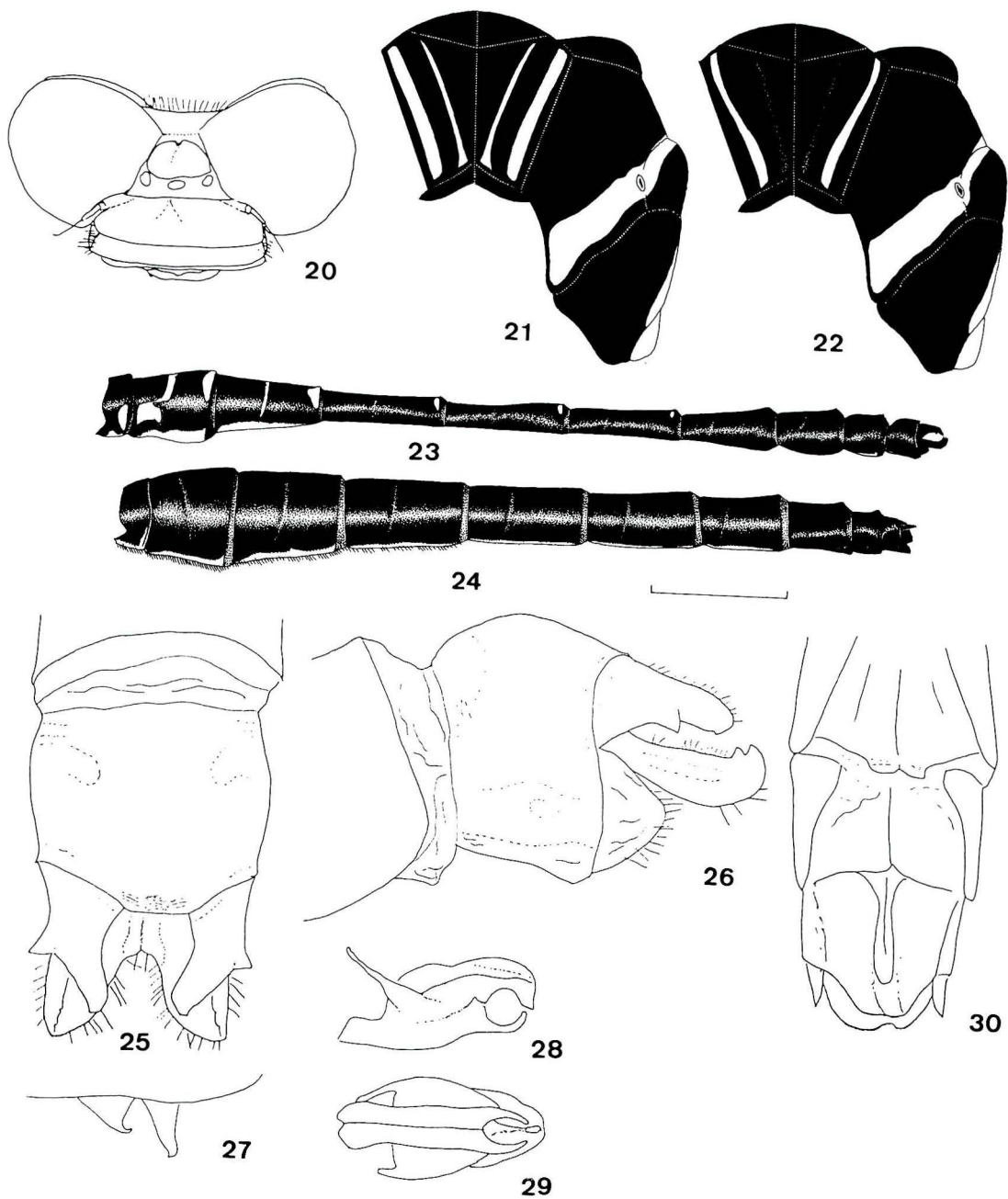
Male. Abdomen (incl. appendage) 66.3-69.7mm in length. Hindwing 48.6-48.9mm in length. maximum width of hind 14.2-14.8mm.

Head black with yellow markings; labium brownish white, with border brownish; labrum black; anteclypeus black; postclypeus yellow, with a pair of black spots at lateral 1/3, and with longitudinal black stripe which is broken at the middle; antefrons black, with a yellow band at upper and lateral edges; the distance between eyes 0.6mm; vertex swollen, eaves-shaped; occiput subconical at upper margin.

Prothorax black, with anterior and lower edges yellow. Pterothorax black, symmetrically with yellow marks as follows: antehumeral stripe which is slightly spread at the dorsal end, humeral stripe which is a little broader than the widest part of the former, fascia consist of postero-ventral edge of mesepimeron, anterior area of metinfraepisternum and anterior 2/3 of metepisternum, and fascia consist of lower edge of metepimeron and all part of metapoststernum.

Wings hyaline, apex decorated with semicircular brownish marks from R1 over IR3; each median space with 2 : 2/2 : 2, 3 : 3/3 : 3; triangles 4 : 4/4 : 4, 4 : 5/5 : 5, that of fore : basal : costal : distal = 1 : 1.46 : 1.53, that of hind : basal : costal : distal = 1 : 0.9 : 1.1. Anal loop 20/20, 25/24; nodal index : 18-29 : 29-17/21-20 : 23-20. 19-30 : 27-18/26-24 : 24-24; pterostigma black, 4.5mm in length, covering 4 cells in the fore, 5.2mm in length and 4.5 cells in the hind.

Abdomen robust, black with yellow markings; 1st segment with small ventral spot and postero-ventral, elongate elliptical spot, these two being barely connected with each other at ventral corner; 2nd segment decorated with 4 maculations: spot on and over auricle, somewhat oblique, short band at medio-dorsal part, dorso-apical elliptical spot and long mark along ventral edge, the 2nd being clearly separated from the



Figs. 20-30. *Chlorogomphus albomarginatus* sp. nov.
21, 23, 25-29: male; 20, 22, 24, 30: female; 20: head in dorsal view; 21, 22: thorax, 23, 24: abdomen; 25: caudal appendage in dorsal view; 26: same in lateral view; 27: accessory genitalia in lateral view; 28: last segment of penis in lateral view; 29: same in ventral view; 30: apical segments of abdomen in ventral view.

mark of opposite site, and the 3rd being barely so; 3rd with 3 maculations, of which the median stripe is extremely thinly connected with the opposite, with apical spot and long mark along ventral edge; 4th to 6th each with apical small spot; 7 to 10th black.

Caudal appendage black. Superior appendage robust, shorter than the inferior, pincers-shaped with stout lateral spine at about basal half; apex bent outside in dorsal view. Inferior appendage slightly broadened towards behind middle in lateral

view, parallel-sided, bilobed with inner margins rounded; each apex with two spines on dorsal part, the apical one of which is rather larger than the anterior.

Accessory genitalia with anterior lamina rapidly thinner towards apex, which is thin and strongly hooked dorsad; hamulus posterioris slender, with apex a little pointed anteriad.

Penis with vesicle squarely, moderately grooved medially, and squarely projected ventrad; 2nd curved ventrad, with spine about half shorter than the 3rd; 4th bell-shaped, with a pair

of long straight projections about half shorter than 4th, with apices of ventral plate shaped as pincers and reflexed upwards; dorsal part slightly longer than ventral plate, nearly truncate at apex and protruded as bill ventrad in lateral view, and longitudinally grooved medially in anterior half, with a pair of raisings along the groove not so developed.

Female. Abdomen (incl. appendage) 58.6mm in length. Hindwing 55.1mm in length with maximum width 23.4mm.

Maculations of head and thorax similar to male, but wings and abdomen very different.

Head coloration as in male; vertex gently protruded, with a pair of callosities on the raising; occiput flat; eyes more widely separated (1.1mm).

Pterothorax with color pattern as in male; antehumeral stripe almost disappeared; humeral stripe slightly slenderer than in male.

Wings short and broad. Fore wing decorated with blackish marking in basal about 2/3, the apical margin being oblique, exceeding 1/3 of the distance between pterostigma and node and reaching pterostigma through costal space, with vague milky white mark at middle along apical margin of the former blackish marking. Hind wing with blackish marking in basal about 1/2, the apical margin oblique and hardly reaching pterostigma through costal space, with basal hyaline mark as a comma-shaped bead, and with a vague milky white band along apical margin of the former blackish marking; triangles 5 : 7/5 : 4, that of fore : basal : costal : distal = 1 : 1.2 : 1.1, that of hind : basal : costal : distal = 1 : 0.7 : 1.1; anal loop 31/34-celled. Nodal index : lost-30 : 30-17/20-22 : 22-20; pterostigma black, 5.1mm in length, and covering 4.5 cells in the fore, 5.6mm in length, and 6 cells in the hind.

Abdomen robust, especially in basal 3 segments, without markings excepting yellow sternite.

Cerci minute, about 2/3 times as long as 10th segment. Valvula valvae trapezoidal. Tenth ventral lobe slightly exceeding paraproct.

Distribution. N. Vietnam.

Type series. Holotype, ♂, Mt. Tamdao, near Hanoi, N. Vietnam, 31. V. 1993, H. Karube leg. Allotype, 1 ♀, same locality as the holotype, 19. V- 2. VI. 1991, Native leg. Paratype : 1 ♂, same locality as the holotype, 3. V. 1994. H. Karube leg.

Notes. Female of this new species strangely resembles to *Ch. nakamurai* at first sight, but is obviously distinguished from that by the characters of head, appendage, etc.

Chlorogomphus nakamurai sp. nov.

(Figs. 31-41)

Male. Abdomen (incl. appendage) 56.5-58.8mm in length. Hindwing 50.3-51.4mm in length, with maximum width 17.3-

17.9mm.

Head black; labium brownish white with margin brown; labrum black; anteclypeus black; postclypeus black, with a pair of yellow Y-shaped spots on the middle; antefrons black, with broad yellow band at anterior 1/3 of dorsal part, which is not reaching lateral edge; the distance between eyes 0.9mm; vertex swollen, with U-shape notch at dorsal part; occiput black, with apical ridge swollen.

Prothorax black with anterior margin narrowly yellow. Pterothorax black with yellow marks: antehumeral stripe thin, slightly broadened towards lower apex; humeral stripe thin, rather broader than the former, not reaching mesinfraepisternum; anterior 3/4 of metepisternum and anterior border of metinfraepisternum yellow, the marking being tapered ventrad; ventral margin of metepimeron and metapoststernum yellow.

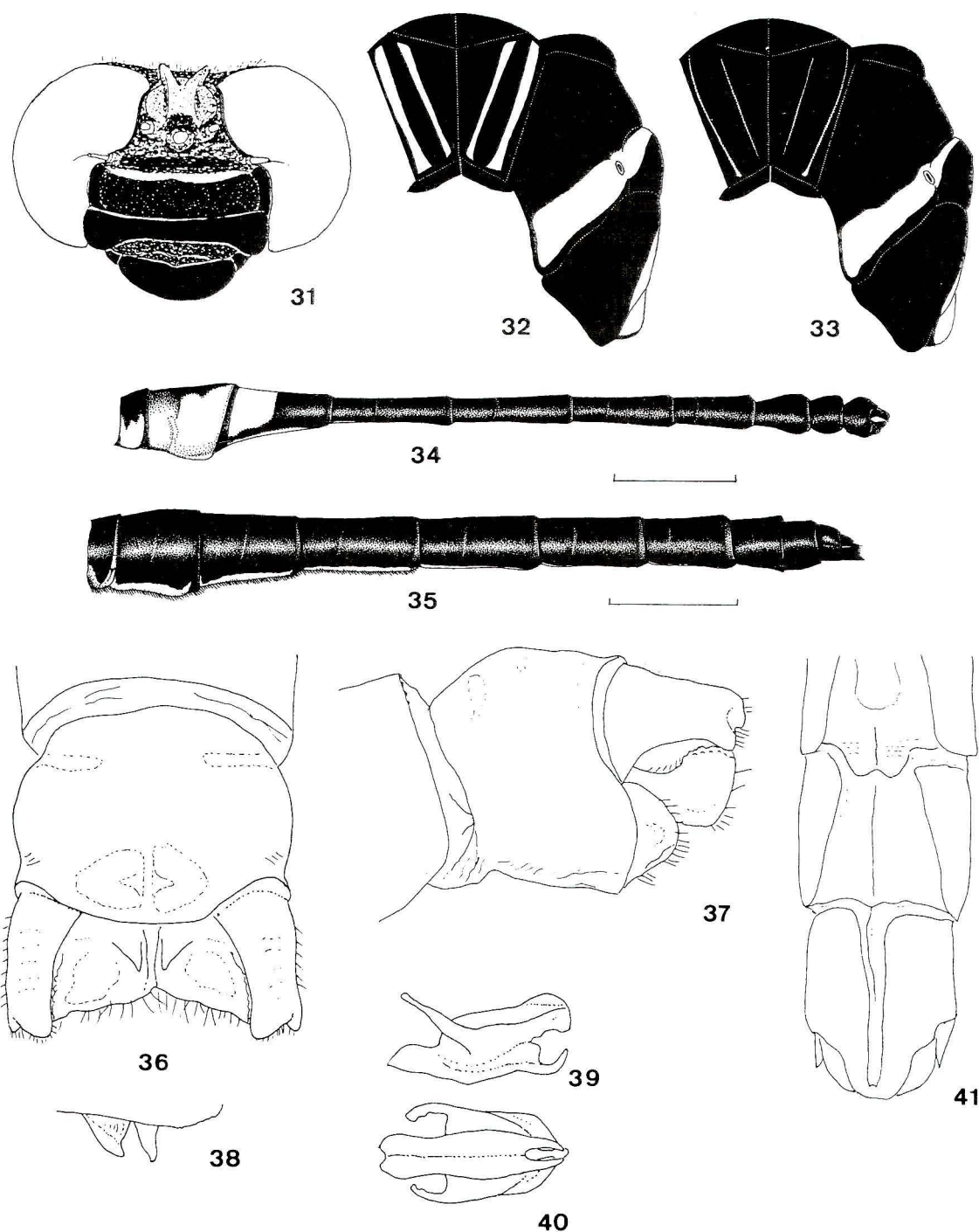
Wings hyaline, with apex blackish marks; median space with 3 or 2 cross veins of the fore and 2 cross veins of the hind; triangles 4 : 4/3 : 4, 3 : 2/4 : 4, 3 : 3 : 3/3 : 4, 3 : 3/2 : 3, 3 : 3 : 3/3 : 3, that of the fore : basal : costal : distal = 1 : 1 : 3.1, that of the hind : basal : costal : distal = 1 : 0.8 : 1.2; anal loop 16~19-celled; nodal index : 18-30 : 27-18/23 : 22 : 24 : 23, 17-27 : 25 : 16/19-21 : 22-20, 20-30 : 29-19/25-23 : 21 : 22, 18-32 : 34-19/21-23 : 26-21, 19-29 : 29-17/22-22 : 23-22; pterostigma black, 4.7mm in length, and covering 3.5 cells in the fore, 50.5mm in length and 4.5-cells in the hind.

Abdomen slightly thickened at apical 3 segments, black with yellow markings: 1st segment with large ventral spot; 2nd segment largely yellow, with black dorsal spot; 3rd yellow at basal 1/2, with ventral margin yellow (these three yellow maculations forming very broad yellow band) 4th to 10th entirely black.

Caudal appendage black. Superior appendage robust and short, faintly curved inwards, with obliquely truncated at apex, with ventral spine near apex. Inferior appendage very short and robust, with a pair of acute projections on the middle, broadly truncate as dull V-shape at apex in dorsal view; apical 1/2 rapidly thickened and reflexed upwards, with many minute conical granules on surface.

Accessory genitalia with anterior lamina rapidly thinner towards apex, deeply depressed except arounding, with apex not so pointed; hamulus posterioris slender and rather straight, with apex hardly pointed.

Penis with vesicle deeply, narrowly, longitudinally and roundedly grooved at the middle, triangularly protruded ventrad in lateral view; 2nd curved ventrad, with spine about 1/3 length of 3rd; 4th longitudinally pentagonal, with a pair of long, twisted projections which are about 2/3 length of 4th, with ventral plate pincer-shaped, somewhat abruptly reflexed upwards at each apex, with dorsal part very faintly exceeding



Figs. 31-41. *Chlorogomphus nakamurai* sp. nov.

32, 34, 36-40: male; 31, 33, 35, 41: female; 31: head in frontal view; 32, 33: thorax; 34, 35: abdomen; 36: caudal appendage in dorsal view; 37: same in lateral view; 38: accessory genitalia in lateral view; 39: last segment of penis in lateral view; 40: same in ventral view; 41: apical segments of abdomen in ventral view.

apex of ventral plate, longitudinally grooved medially in anterior 1/4, and roundedly truncate at apex in lateral view.

Female. Abdomen (incl. appendage) 61.9mm in length. Hindwing 59.9mm in length, with maximum width 24.4mm.

Head broad, largely black; labium brownish white; labrum black; anteclypeus black; postclypeus very broad, entirely

black; ridge of antefrons a little light-coloured; vertex with a pair of interesting protuberances posteriad, which is very big and long and reaches border of occiput; occiput connected with vertex, wide and narrow; eyes very widely separated, distance between eyes 2.6mm, the most nearest point situated at border of occiput.

Prothorax black, yellow at posterior and lateral edges. Pterothorax robust, black with yellow marks : antehumeral stripe very narrow, absent on upper and lower part, humeral stripe narrow, disappeared on ventral part, anterior half of metepisternum yellow, and post-ventral edge of metepimeron and metapoststernum yellow.

Wings broad ; each basal half covered with blackish mark except basal corner, this mark being marginate by milky white band, and extending a little over node ; apex with small blackish spot ; median space : $3 : 2/2 : 3, 2 : 2/3 : 2$; triangles $5 : 5/5 : 5, 6 : 6/5 : 6, 5 : 6/5 : 5$, that of fore : basal : costal : distal = $1 : 1.3 : 1.4$, that of hind : basal : costal : distal = $1 : 0.7 : 1.1$; anal loop 32/31-celled, 37/39, 35/31 ; nodal index : 20-29 : 31-18 : 23-22 : 22-22, 20-29 : 32-20/21-24 : 23-22, 20-31 : 32-20/22-25 : 24-23 ; pterostigma black, 5.4mm in length, and covering 5 cells in the fore, 5.6mm in length and 6 cells in the hind.

Abdomen robust, nearly blackish ; each ventral edge of 1st to 7th segments, yellow line, which is gradually becoming thinner towards apex.

Cerci minute, about 1/2 shorter than 10th segment. Valvula valvae trapezoidal. Tenth with ventral lobe, slightly exceeding paraproct at apex.

Distribution. N. Vietnam.

Type series. Holotype, ♂, Cuc Phuong, near Hanoi, N. Vietnam, 29. V. 1993, H. Karube leg. Allotype, ♀, same locality as the holotype, 28. V. 1991, S. Nakamura leg. Paratypes : 6 ♂♂, same data as holotype ; 5 ♂♂ 2 ♀♀, same locality as the holotype, 30. IV. 1994, H. Karube leg ; 1 ♂, same locality as the holotype, 1. V. 1994, H. Karube leg.

Notes. This species was found only along a fine stream in lime stone tablelands, which flows the distance of about 100m through the forest and then is inhaled below a chiff. Male has a habit of patrolling on the upper stream in dark forest, and female lays eggs into small muddy pools near the source stream.

Chlorogomphus sachiyoae sp. nov.

(Figs. 42-52)

Male. Abdomen (incl. appendage) 67.6mm in length. Hindwing 45.1mm in length, with maximum width 14.8mm.

Head black with yellow markings, with frons triangularly protruded ; labium whitish yellow ; labrum black ; anteclypeus black, with lower edge yellow ; postclypeus yellow ; ridge of antefrons with triangular yellow band ; eyes almost meeting, the distance 0.5mm ; vertex eaves-shaped ; occiput small, subconical.

Prothorax black, with anterior margin yellow. Pterothorax black, with yellow marks as follows : antehumeral stripe expanded at the dorsal apex ; humeral stripe about 2.5 times as wide as the former ; mesinfraepisternum with yellow mark which covers posterior half and is connected with humeral

stripe ; outer sides of fore and mid coxae yellow ; metepisternum yellow, except for blackish posterior margin ; metinfraepisternum with large spot at posterior half, which is connected with the former band ; metapoststernum and lower edges of metepimeron yellow.

Wings hyaline ; each median space with two cross veins ; triangles $2 : 4/3 : 2$, that of fore : basal : costal : distal = $1 : 1.4 : 1.2$, that of hind : basal : costal : distal = $1 : 1.3 : 1.4$. Anal loop 11/12 ; nodal index : 12-21 : 25-12/13-19 : 20-15 ; pterostigma black, 3.7mm in length and covering 3.5-cells in the fore, 4.1mm in length and 3-cells in the hind.

Abdomen slender and long, black with yellow markings as follows : large spot at ventral half of 1st segment, two bands in 2nd, one is oblique, runs from antero-ventral margin to medio-dorsal area, is connected with the former spot at anterior margin, rapidly becomes thinner at the upper part and does not reach the dorsal top, another band just before 3rd is about 1/6 width of 2nd and rectangularly prolongs behind 1st along ventral edge, very thin ring at middle of 3rd, each dorso-apical spot of 3rd to 6th, of which 5th one almost disappears and 6th one is the largest.

Caudal appendage black, rather slender. Superior appendage curved inwards, with stout oblique ventral spine at basal 3/5 ; apex asymmetrically bilobed in dorsal view, with outer process triangularly protruded ventrad. Inferior appendage slightly longer than the superior, thickened before apex in lateral view, and somewhat curved upwards at apex, with 2 minute spines on dorso apical area ; apex obliquely truncate with emarginate middle part in dorsal view.

Accessory genitalia with anterior lamina tapered towards apex, which is curved posteriad ; hamulus posterioris long, waved and thick, with apex a little pointed anteriorly.

Penis delicate ; vesicle very shallowly excavated medially ; 2nd strongly curved ventrad, with spine which is about 1/2 times as long as 3rd ; 4th triangular, with a pair of projections which are about 1/3 length of 4th, with each lobe of ventral plate straight and slender, weakly reflexed upwards at apex, with dorsal part a little longer than ventral plate, nearly truncate at apex, with median groove running in anterior 1/3.

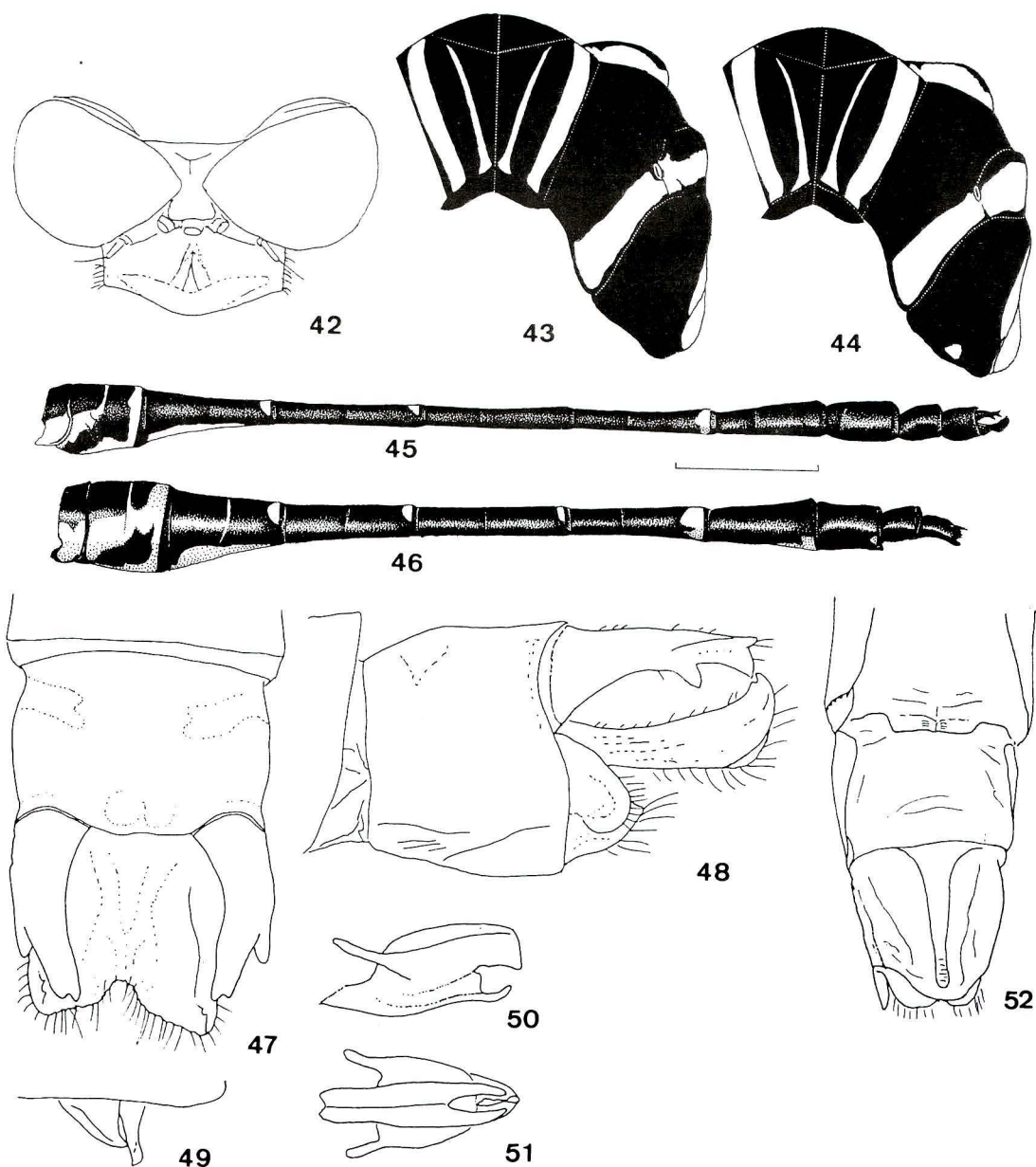
Female. Abdomen (incl. appendage) 61.7mm in length. Hindwing 48.3mm in length, with maximum width 15.8mm.

Maculations almost similar to those of male.

Head with coloration as in male ; frons gently protruded forwards ; occiput flat ; eyes more widely separated (1.1mm) .

Pterothorax with color pattern as in male.

Wings hyaline ; triangles $3 : 4/3 : 3$, that of fore : basal : costal : distal = $1 : 1.7 : 1.6$, that of hind : basal : costal : distal = $1 : 1.2 : 1.3$; anal loop 16/17-celled, nodal index : 13-23 : 23-14/18-18 : 17-16 ; pterostigma black, 4.1mm in length and covering 3.5 cells in the fore, 4.5mm in length and 3.5 cells in the hind.



Figs. 42-52. *Chlorogomphus sachiyoae* sp. nov.

42, 43, 45, 47-51: male; 44, 46, 52: female; 42: head in dorsal view; 43, 44: thorax; 45, 46: abdomen; 47: caudal appendage in dorsal view, 48. same in lateral view; 49: accessory genitalia in lateral view; 50: last segment of penis in lateral view; 51: same in ventral view; 52: apical segments of abdomen in ventral view.

Abdominal markings similar to those of male; yellowish maculations of 2nd more developed, of which the oblique band is connected with apical ring; 5th apical spot distinct.

Cerci minute, about $\frac{2}{3}$ times as long as 10th segment. Valvula valvae widely trapezoidal. Tenth ventral lobe not exceeding paraproct.

Distribution. N. Vietnam.

Type material. Holotype, ♂, Mt. Tamdao, near Hanoi, N. Vietnam, 2. V. 1994, H. Karube leg. Allotype, ♀, same locality as the holotype, 8. V. 1994, native leg.

Notes. This new species closely resembles to *Ch. sp.* from S. China (will be described by Karube). These two belong to same group.

Chlorogomphus nasutus Needham, 1930

(Figs. 53-62)

Chlorogomphus nasutus Needham, 1930, Zool. sinica, (A) 11 (1): 97; Fraser, 1933, Mem. Indian Mus., 9: 205-260; Klots, 1947, Amer. Mus. Novit., 1341: 3-4; Chen, 1950, Q. Jl. Taiwan Mus., 3: 142; Asahina, 1961, Tombo, 4: 3-

5 ; Asahina, 1966, Ent. Medd., 27 : 225 ; Asahina, 1978, Kontyu, 46 : 15 ; Asahina, 1978, Tombo, 21 : 7-9.

Male. Abdomen (incl. appendage) 63.5-67.2mm in length ; hindwing 48.1-52.2mm in length, with maximum width 14.6-15.8mm.

Head with antefrons distinctly triangularly protruded anteriad and black with yellow marks ; labium brownish yellow ; labrum black ; anteclypeus black with upper part yellow ; postclypeus yellow, black at lower edge, faintly with small black spot at about 1/3 from each side ; antefrons black, with apical 1/4 broadly yellow ; eyes almost meeting, the distance 0.5mm ; vertex roundly swollen, with median notch at dorsal part ; occiput black, subconical.

Prothorax black with anterior margin yellow. Pterothorax black with yellow marks as follows : antehumeral stripe tapered ventrad ; humeral stripe about twice as wide as the former, and a little curved inwards ; posterior half of mesinfraepisternum with yellow patch ; coxae entirely yellow ; anterior 2/3 of metepisternum obliquely with yellow band ; lower edge and dorsal small spot of metepimeron yellow ; metapoststernum entirely yellow.

Wings nearly hyaline ; median space with 2 cross veins ; triangles 3 : 4/3 : 3, 2 : 3/3 : 3, 4 : 4/3 : 3, 3 : 4/3 : 3, 4 : 4/3 : 3, that of fore : basal : costal : distal = 1 : 1.3 : 1.4, that of hind : basal : costal : distal = 1 : 1.2 : 1.5 ; anal loop 9-13-celled, sometimes 16-celled ; nodal index : 17-25 : 26-17/22-19 : 21-18, 18-28 : 26-16/18-21 : 22-17, 18-25 : 26-17/21-23 : 23-19, 15-24 : 23-15/19-23 : 21-20, 14-25 : 24-13/16-20 : 19-18 ; pterostigma black, 4mm in length, and covering 4 cells in the fore, 4.2mm in length and 4 cells in the hind.

Abdomen slender and long, black with yellow markings ; 1st segment with ventral patch ; 2nd segment with large spot at antero-ventral part and with apical ring, the former with two stripes, one is prolonged anteriad along ventral adge, another is rectangularly so ventrad ; 3rd with very narrow indistinct ring at medio-dorsal part ; 3rd to 6th each with yellow line at sternite, decorated with a pair of spots at dorso-apical area though very small or sometimes disappearing in 5th, of which a pair of 6th are the largest and are spread at posterior 1/6 ; 7th-10th black.

Caudal appendage black. Superior appendage slightly shorter than the inferior, rapidly becoming thinner towards apex ; lateral spine stout and robust, situated at basal 1/3. Inferior appendage slender, almost parallel-sided, clearly bilobed, deeply and widely emarginated as V-shape at apex, each lobe with two spines at dorsal apex and narrowly rounded at apex in dorsal view.

Accessory genitalia moderate ; anterior lamina gradually becoming thinner towards apex, deeply depressed except for margins ; hamulus posterioris robust, with apex sharply pointed, and curved anteriad at apex.

Penis moderate in shape ; vesicle hemispherical in ventral apex, the projection being very shallowly and longitudinally scooped on ventral surface ; 2nd strongly curved ventrad, with spine about 1/2 length of 3rd ; 4th bell-shaped, with a pair of long projections which are about 0.75 times as long as 4th, with a pair of lobes of ventral plate robust and straight, with apex slightly reflexed upwards ; apex of dorsal part of 4th slightly swollen anteriorly, exceeding ventral plate ; median notch of 4th running in anterior 1/2, with a pair of risings along the notch.

Female. Abdomen (incl. appendage) 69.5-76.7mm in length ; hindwing 54.3-57.5mm in length, with maximum width 18.4-18.8mm.

Maculations similar to those of male, though more spread.

Head broader than in male ; frons faintly protruded ; eyes widely separated (about 1.1mm) ; vertex more expanded, with three small projections on dorsum ; occiput subconical.

Yellow markings of pterothorax larger than in male ; antehumeral stripe narrow, disappeared at lower part ; humeral stripe 3 times as wide as the former.

Wings hyaline ; median space with 2 cross veins ; triangles 4 : 3/4 : 4, 3 : 3/4 : 4, 4 : 4/5 : 5, that of fore : basal : costal : distal = 1 : 1.3 : 1.3, that of hind : basal : costal : distal = 1 : 1.1 : 1.2 ; anal loop 14-20-celled ; nodal index : 16-26 : 27-17/17-22 : 22-20, 17-25 : 24-18/21-21 : 19-20, 14-27 : 28-15/18-22 : 23-20 ; pterostigma black, 4.6mm in length and covering 4 cells in the fore, 4.8mm in length and 4 cells in the hind.

Abdomen expanded in basal three and 7th to 9th segments, cylindrical in 4th to 6th, black with yellow markings as follows : 1st with large spot at ventral part, 2nd with evidently large mark at ventral more than half and a thin stripe at dorsal half as in fig. ; a pair of yellow spots of 3rd to 6th sometimes disappeared in 3rd and 4th, 6th of which are enlarged in apical 1/4.

Cerci about half shorter than 10th segment ; valvula valvae broadly trapezoidal, with middle part of apex sharply pointed. Tenth ventral lobe parabolically protruded at apex, clearly exceeding paraproct at apex.

Distributions. S. China, N. Vietnam.

Materials examined. Mt. Tamdao, near Hanoi, N. Vietnam : 1 ♂ 1 ♀, 20. V. 1991, M. Takakuwa leg ; 2 ♂♂, 30. V. 1993, H. Karube leg. 29 ♂♂ 2 ♀♀, 19. V.-2. VI. 1993, Native leg.

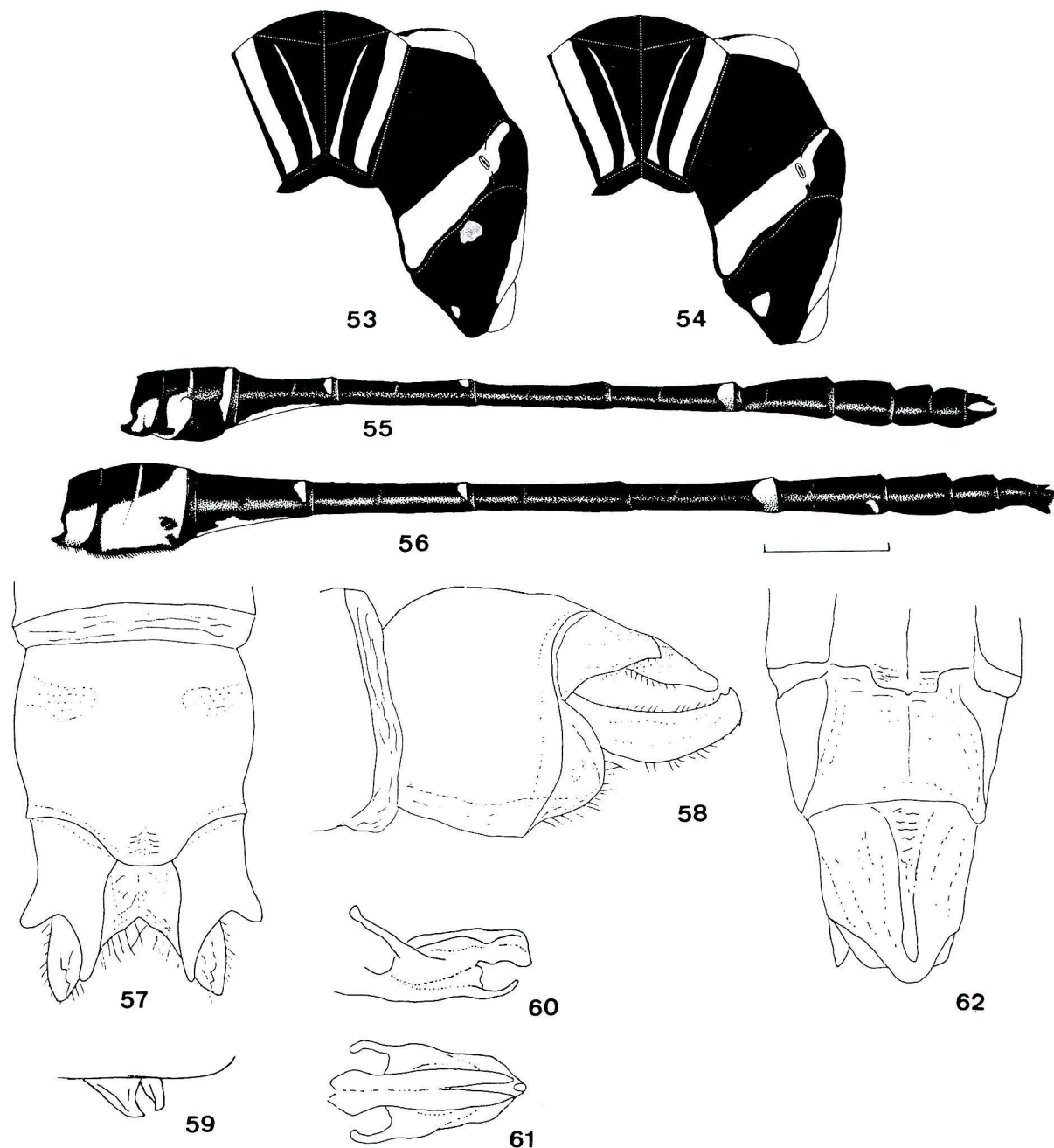
Notes. This is the first record from Vietnam. Vietnamese specimens somewhat differ from those of CS. China in the structure of caudal appendage.

Chlorogomphus miyashitai sp. nov.

(Figs. 63-73)

Male. Abdomen (incl. appendage) 58.1mm in length. Hindwing 42.7mm in length, with maximum width 12.1mm.

Head slightly, triangularly projected anteriorly, black with yellowish markings ; labium pale yellow ; labrum black ;



Figs. 53-62. *Chlorogomphus nasutus* Needham.

53, 55, 57-61: male; 54, 56, 62: female; 53, 54: thorax; 55, 56: abdomen; 57: caudal appendage in dorsal view; 58: same in lateral view; 59: accessory genitalia in lateral view; 60: last segment of penis in lateral view; 61: same in ventral view; 62: apical segments of abdomen in ventral view.

anteclypeus yellow; postclypeus yellow, with a pair of white markings at about 1/3 from each side; antefrons black, with yellow band at upper edge; distance between eyes 0.5mm; vertex swollen, eaves-shaped, with dorsal part almost flat; occiput subconical, yellow with black border.

Prothorax black, with anterior and lateral edges yellow. Pterothorax black with yellow marks as follows: antehumeral stripe expanded at upper end; humeral stripe about 2.5 times as wide as median part of the former, and faintly broadened

and curved inwards under the middle; mesinfraepisternum yellow; mesepimeron with narrow stripe at anterior part, which is broadened ventrad and broken at middle and upper part; metepisternum with broad band at posterior 3/4; metinfraepisternum with spot at anterior half; metepimeron with two narrow stripes, one is situated at anterior 1/3 and somewhat broadened towards dorsal apex, and another is so at lower edge; metapoststernum largely yellow.

Wings hyaline; each median space with 2 cross veins;

triangles 2 : 2/2 : 2, that of the fore : basal : costal : distal = 1 : 1.4 : 1.4, that of the hind : basal : costal : distal = 1 : 1.3 : 1.5 ; anal loop 9-celled ; nodal index : 13-24 : 23-13/16-18 : 21-17 ; pterostigma black, 2.9mm in length and covering 3 cells in the fore, 2.9mm in length and 2.5 cells in the hind.

Abdomen slender, black, symmetrically with yellow markings as follows : large spot at ventral half of 1st, antero-ventral large marking and annulate fascia just before apical margin of 2nd (two border at lower part), the former being prolonged dorsad and connected with the maculation of opposite side, antero-ventral spot of 3rd, each apical spot of 3rd to 7th, of which the 7th one is the largest and about 1/6 width of 7th segment, and each ventral patch of 6th to 9th, of which the 6th and 9th ones are very small ; 8th to 10th black.

Caudal appendage black. Superior appendage slightly longer than the inferior, slender parallel-sided but slightly curved inwards at inner margin, thinned at about apical half ; ventral spine short and robust, situated at basal 1/2 ; each apex faintly emarginate in dorsal view. Inferior appendage parallel-sided, belobed, swollen ventrally behind the middle, with two spines at dorso-apical area in lateral view, semicircularly excavated apically on dorsum ; apex somewhat bilobed with sinuate middle, with each lobe triangularly pointed at the tip.

Accessory genitalia with anterior lamina rapidly thinned towards apex and acutely reflexed upwards ; hamulus posterioris slender, waved, with apex pointed antiad.

Penis with vesicle notched ventrally at median part, squarely projected ventrad in lateral view ; 2nd curved ventrad, with spine which is about 2/3 length of 3rd segment ; 4th slenderly triangular, with a pair of long projections which are about 2/3 of 4th, with ventral plate very deeply divaricate at apical half, with rather deeply reflexed upwards, with dorsal part longer than ventral plate, grooved medially in anterior 2/3 and somewhat obliquely truncate and broadly protruded ventrad at apex in lateral view.

Female. Abdomen (incl. appendage) 62.5mm in length ; hindwing 47.8mm in length, with maximum width 15.6mm.

Maculations similar to those of male.

Head black with yellow markings ; labium whitish yellow ; labrum black, with a pair of yellow markings at middle ; anteclypeus black, with yellow patch at the medio-dorsal part ; postclypeus yellow on all over ; lateral and dorsal ridges of antefrons yellow ; vertex eaves-shaped with median notch ; occiput pyramidal and yellowish ; distance between eyes 0.8mm.

Prothorax black, posterior and lateral edges margined with yellow. Pterothorax black with yellow ; antehumeral stripe narrow and disappeared at lower part ; humeral stripe waved near the middle.

Wings hyaline, tinged with brown ; median space with cross veins : 2 : 2/3 : 2 ; triangles 3 : 3/4 : 4, that of fore : basal : costal :

distal = 1 : 1.8 : 1.6, that of hind : basal : costal : distal = 1 : 1.2 : 1.4 ; anal loop 15/16, nodal index : 12-23 : 23-12/13-18 : 19 : 14 ; pterostigma black, 3.3 mm in length and covering 3.5 cells in the fore, 3.8mm in length and 3 cells in the hind.

Abdominal maculations somewhat different from those of male : 2nd with broad oblique yellow band from antero-ventral margin just before postero-dorsal margin, with ventral edge black ; 3rd without ventral patch ; 7th maculation prolonged antiad along lateral margin.

Cerci about 1/2 shorter than 10th segment. Valvula valvae trapezoidal. Tenth ventral lobe exceeding paraproct at apex.

Distribution. NE Laos.

Type series. Holotype, ♂, Xien Kwang, NE. Laos, 4. IV. 1993, T. Miyashita leg. Allotype, ♀, same locality as the holotype, 22. VI. 1993, T. Miyashita leg.

Notes. This new species closely relates to *Ch. selysi*, but easily distinguished by the short superior appendage.

Chlorogomphus takakuwai sp. nov.

(Figs. 74-84)

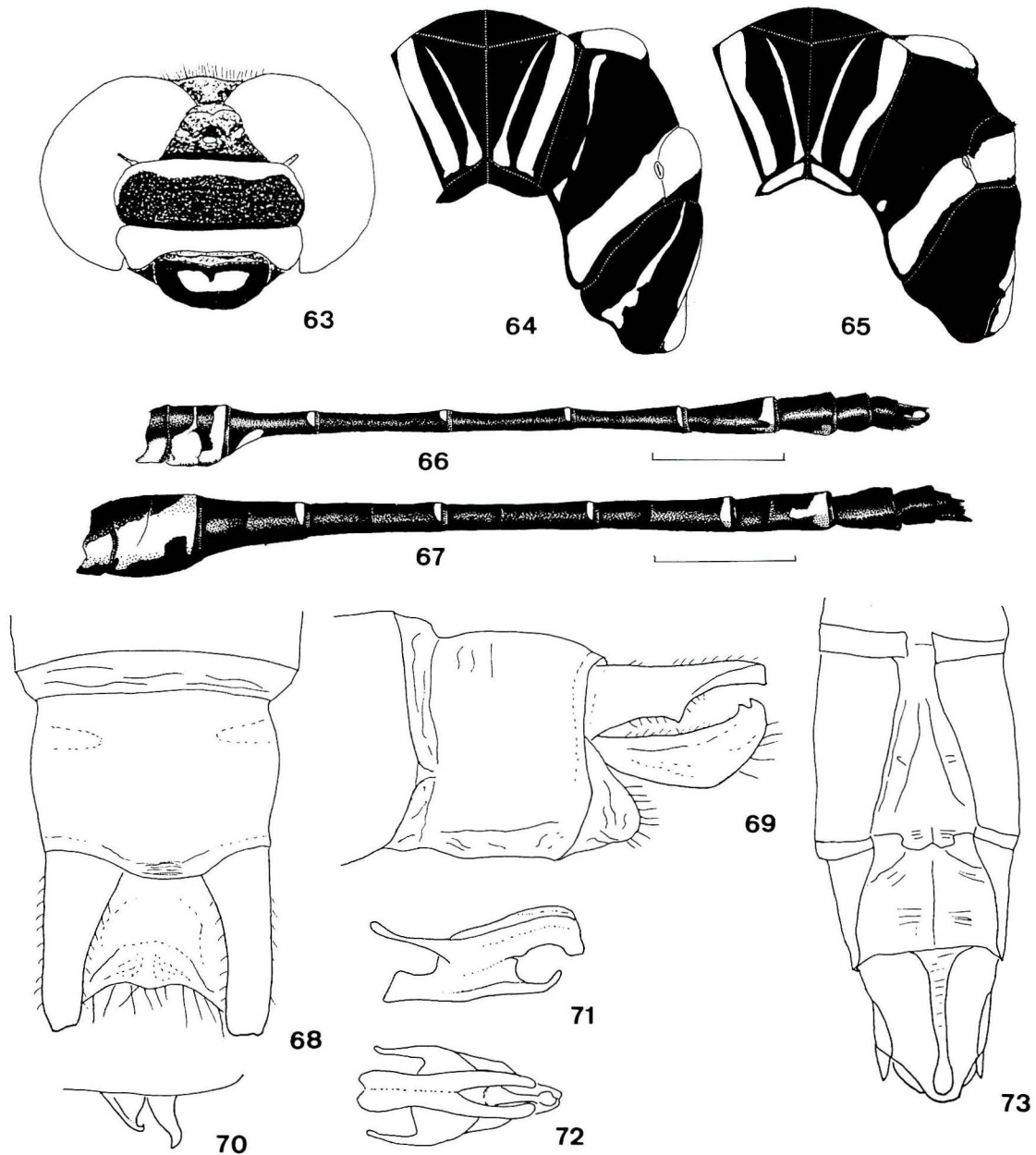
Male. Abdomen (incl. appendage) 66.3-69.7mm in length. Hindwing 48.6-48.9mm in length, with maximum width 14.2-14.8mm.

Head triangularly prolonged anteriorly, black with yellow markings ; labium pale yellow, with anterior border brownish ; labrum black ; anteclypeus yellow, with each side black ; postclypeus yellow, with ventral border black ; antefrons black, with upper edge yellow ; distance between eyes 0.4mm ; vertex swollen, eaves-shaped ; occiput subconical.

Prothorax black, with anterior and lower edges yellow. Pterothorax black with yellow marks ; antehumeral stripe rather broad, expanded at upper apex ; humeral stripe about as wide as upper part of the former, and faintly broadened and curved outwards under the middle ; mesinfraepisternum with short fascia at upper part ; metepisternum yellow except for black fascia along posterior margin, the yellow band being about 4 times as wide as the marginal black one and truncately broken below metastigma ; metinfraepisternum with large spot at middle ; metepimeron with short fascia at upper part ; ventral edge of metepimeron and ventral half of poststernum black.

Wings hyaline with brownish apices ; each median space with 2 cross veins ; triangles 3 : 2/3 : 3, 2 : 3/2 : 2, 2 : 3/2 : 2, 2 : 2/2 : 2, that of the fore : basal : costal : distal = 1 : 1.5 : 1.5 ; that of the hind : basal : costal : distal = 1 : 1.3 : 1.5 ; anal loop 8-11-celled ; nodal index : 15-25 : 24-15/18-20 : 19-19, 14-25 : 25-14/18-20 : 20-18, 15-25 : 24-17/18-19 : 20-20, 16-23 : 24-13/19-22 : 19-18 ; pterostigma black, 3.8mm in length and covering 3.5-cells in the fore, 4.1mm in length and 4.5-cells in the hind.

Abdomen slender, black, symmetrically with yellow markings as follows : spot at ventral half of 1st, antero-ventral



Figs. 63-73. *Chlorogomphus miyashitai* sp. nov.

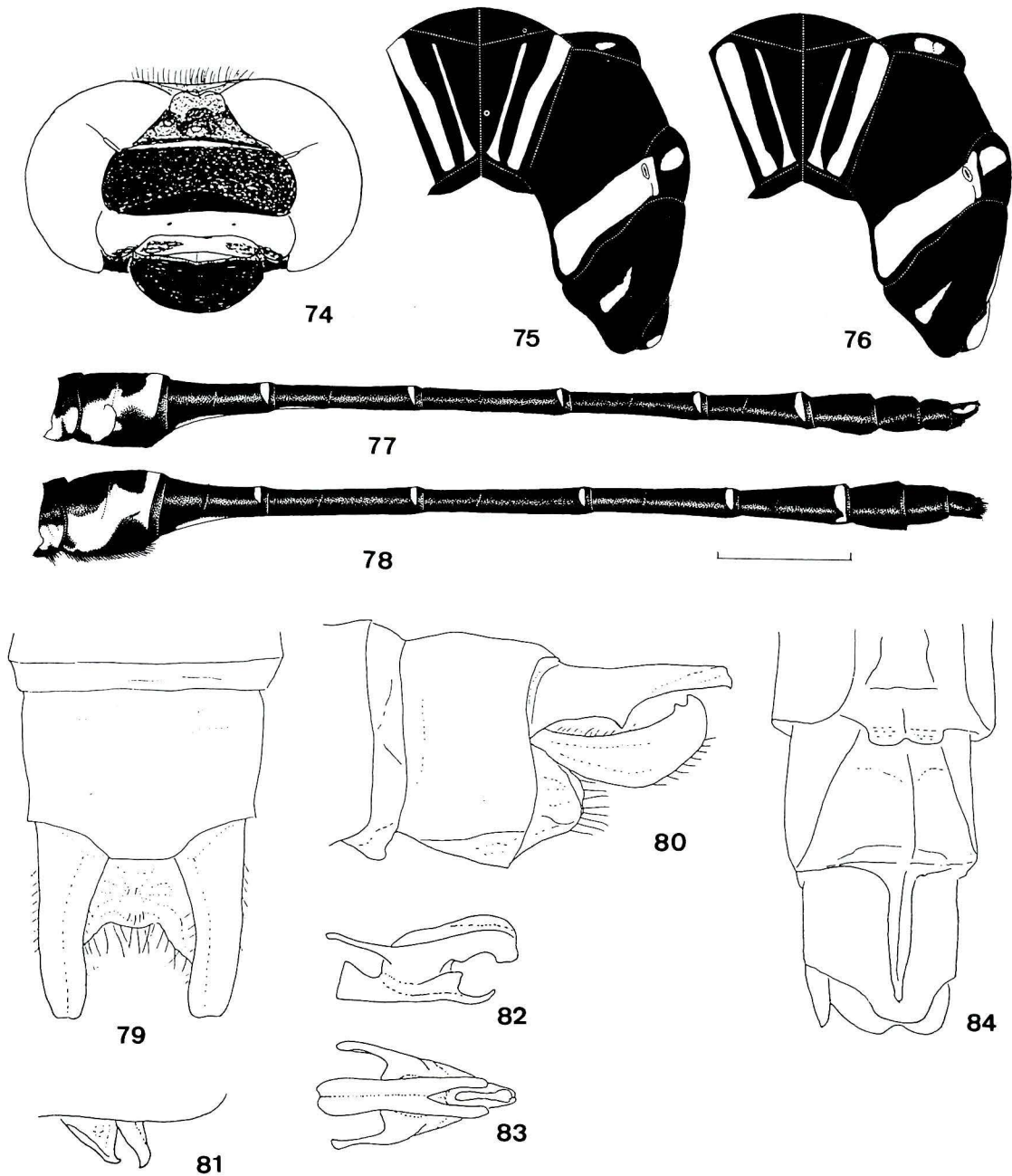
64, 66, 68-72: male; 63, 65, 67, 73: female; 63: head in frontal view; 64, 65: thorax; 66, 67: abdomen; 68: caudal appendage in dorsal view; 69: same in lateral view; 70: accessory genitalia in lateral view; 71: last segment of penis in lateral view; 72: same in ventral view; 73: apical segments of abdomen in ventral view.

and apico-dorsal markings in 2nd, which are connected with each other at middle area, the former being connected with spot of 1st at anterior margin, each ventral fascia of 3rd and 4th, each apical ring of 3rd to 7th, the 7th one of which is the largest; 8th to 10th black.

Caudal appendage black. Superior appendage longer than the inferior, slender and parallel-sided, but slightly curved

inwards at inner margin, with stout ventral spine at basal about $2/5$, thinned from there to apex; apex a little emarginate in dorsal view. Inferior appendage thickened below towards the middle in lateral view, bilobed in apical half; apex trapezoidally truncate, slightly protruded at middle; each lobe triangular, with two spines at dorso-apical area.

Accessory genitalia with anterior lamina rapidly tapered



Figs. 74-84. *Chlorogomphus takakuwai* sp. nov.

75, 77, 79-83: male; 74, 76, 78, 84: female; 74: head in frontal view; 75, 76: thorax; 77, 78: abdomen; 79: caudal appendage in dorsal view; 80: same in lateral view; 81: accessory genitalia in lateral view; 82: last segment of penis in lateral view; 83: same in ventral view; 84: apical segments of abdomen in ventral view.

towards apex, which is suddenly reflexed; hamulus posterioris rather robust, with apex a little pointed anteriorad.

Penis with vesicle squarely projected ventrad and grooved as a stratovolcano in vertical section; 2nd curved ventrad, with spine which is about $1/2$ length of 3rd segment; 4th slenderly triangular, with a pair of long straight projections which are about $1/2$ times as long as 4th, with ventral plate very deeply

divaricate in apical about $1/3$ and weakly reflexed upward, with dorsal part clearly longer than ventral plate, grooved medially in anterior $2/3$ and very faintly obliquely truncate and rather broadly protruded ventrad at apex in lateral view.

Female. Abdomen (incl. appendage) 68.9-69.7mm in length. Hindwing 52.4-55.9mm in length, maximum width 16.7-18.8mm.

Maculations almost as in male.

Head color as in male ; vertex protruded with two swellings ; occiput narrow ; eyes more widely separated (1.2mm) .

Pterothoracic color pattern as in male, but fascia of metinfraepisternum broader.

Wings hyaline, sometimes decorated with reddish brown marking at each base ; each median space with 2 cross veins ; triangles 4 : 4/4 : 4, 4 : 5/5 : 4, that of fore : basal : costal : distal = 1 : 1.5 : 1.4, that of hind : basal : costal : distal = 1 : 1.1 : 1.3 ; anal loop 15-18-celled ; nodal index : 15-26 : 26-17/20-21 : 23-20, 17-28 : 30-15/20-23 : 22-21. Pterostigma black, 3.8mm in length and covering 3 cells in the fore, 4.1mm in length and 3.5 cells in the hind.

Abdomen long, with basal 2 and last 3 segments thickened ; coloration as in male, but yellow mark of 7th developed as a ring just before apex.

Cerci long, as long as 10th segment. Valvula valvae shallowly bilobed. Tenth ventral lobe not exceeding paraproct.

Distribution. N. Vietnam.

Type series. Holotype, ♂, Mt. Tamdao, near Hanoi, N. Vietnam, 19. V- 2. VI . 1993, native leg. Allotype, 1 ♀ , same locality as the holotype, 31. V. 1991, H. Karube leg. Paratypes : same locality as the holotype : 1 ♀ , 16.V.1992. M. Takakuwa leg ; 1 ♂ , 2.VI.1993, S. Nakamura leg ; 1 ♂ 1 ♀ , 19.V- 2.VI.1993, native leg.

Notes. this new species resembles *Ch. miyashitai*, but is easily distinguished from the latter by the large-sized body and structure of caudal appendage.

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